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TWO NEW ARTHROPOD CARAPACES FROM THE BURGESS SHALE (MIDDLE CAMBRIAN) OF CANADA

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Three carapaces of an undescribed arthropod were found by the writer when curating the large Museum of Comparative Zoology collection of Burgess Shale arthropods, collected by P. E. Raymond, H. C. Stetson, W. E. Schevill and C. H. Burgess in August, 1930. Subsequent search through the material in the U. S. National Museum, Washington, D. C., yielded eleven further specimens and two specimens of another new form, which had been set aside for description by C. E. Resser. The writer is indebted to Dr. G. A. Cooper for permission to borrow and describe the U.S.N.M. material and to Dr. H. B. Whittington for the photographs and for criticism of the manuscript.

The USNM specimens came from Walcott's quarry at locality 35k near Field, British Columbia (Walcott, 1911, pp. 51-52; Resser, 1929, p. 2: = locality S11f of Rasetti, 1951, pp. 37-38, 103, 129). The MCZ specimens were also probably collected from this quarry, although it is impossible to be certain of this since the 1930 expedition also collected from "a second layer . . . very fossiliferous . . . some seventy feet further up the mountainside" (Raymond, 1930, p. 32; 1935, p. 205). This second locality possibly corresponds with Rasetti's S11g (1951, pp. 38, 104, 130) and details of the stratigraphy of these two horizons are given in that work. Letters a and b following a specimen number indicate that part and counterpart are present.

Carapace shape alone is insufficient to determine the affinities of any arthropod, as Roger has pointed out (1946, p. 59), and hence it seems better to group such isolated carapaces together as follows.

TRILOBITOIDEA or CRUSTACEA *incertae sedis*

PROBOSCICARIS gen. nov.

Type species. Proboscicaris agnosta sp. nov.

Diagnosis. Carapace valves only known, large, with antero-dorsal region produced into a spatulate beak.

PROBOSCICARIS AGNOSTA sp. nov.

Plate 1, figures 1, 2; Text-figure 1

Diagnosis. Anterior beak prominent; length of posterior margin 0.43 to 0.82 of greatest depth of carapace; posterior margin indented at or near midpoint.

Description. Valves elongate, ranging from shallow to deep. Since the orientation of the valves is unknown, the straight to slightly concave margin will be treated as dorsal and the produced region as anterior. Postero-dorsal angle rounded and obtuse; posterior margin slightly indented at or near its midpoint. Ventral margin moderately convex in posterior half to three-quarters of carapace length; strongly concave in anterior region and separating off a tongue-shaped anterior beak. This beak has been lost from USNM 139866 (see Text-fig. 1) and it seems likely that the distinct outlines shown by USNM 139869 and 139873 (Text-fig. 1) are only due to the loss of this region. The absence of a recognizable rim or doublure prevents certainty on this point.

The valves were doubtless joined by a membranous hinge along the dorsal border as in *Canadaspis*. Only one specimen shows evidence of two valves preserved, and this is shown on Text-figure 1, USNM 139872. Only the anterior beak of the right valve is preserved and this is displaced anteriorly relative to the almost complete left valve.

A reticulate pattern may be seen in patchy areas on USNM 139867 and 139873. The wrinkles subparallel to the ventral margin of USNM 139866 (Text-fig. 1) are clearly due to flattening of the originally convex test. Specimens USNM 139867, 139870, 139871, 139873, MCZ 5979/2 and MCZ 5979/3 are blotched by the alga *Morania parasitica* Walcott, previously recorded on *Canadaspis* and figured by Walcott (1919, p. 232, pl. 50, fig. 1) on a carapace of *Hurdia victoria* Walcott.

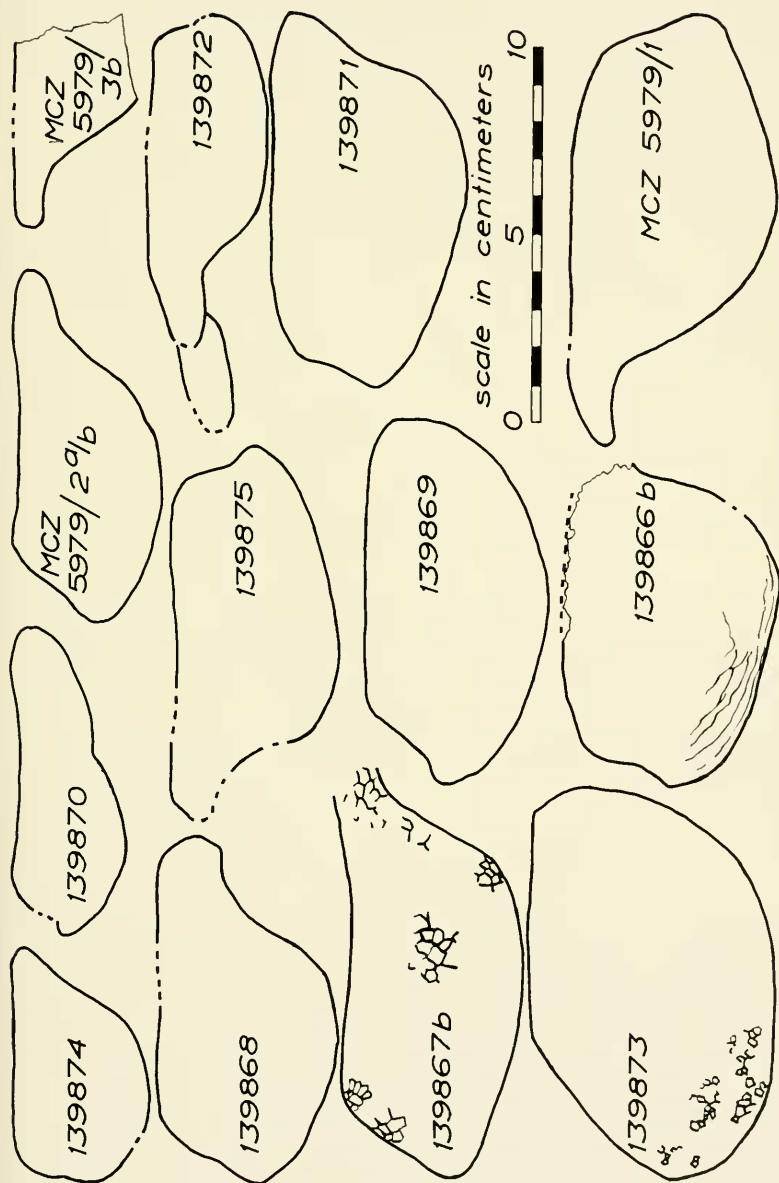


FIG. 1. Outline drawings of thirteen of the fourteen known specimens of *Proboscicaris agnosta* gen. et sp. nov. with catalog numbers indicated. Holotype — USNM 139871.

Remarks. The form of the carapace is so distinct that little confusion is possible with previously described species. Such a small beaked specimen as USNM 139874 approaches *Canadaspis perfecta* (Walcott) in outline, but the posterior and antero-ventral embayments readily distinguish the new form. Some specimens of *Hurdia victoria* in the Museum of Comparative Zoology show an indentation of the ?posterior margin similar to that in *Proboscicaris*, and in addition show an identical reticulation of the carapace surface, so that fragments of the posterior ends of the two forms might prove difficult to distinguish. Large-mesh reticulation also occurs in *Tuzoia* and *Carnarvonia* (Walcott, 1912, pp. 157-158, 165, 187, 189) so that this character is of little value for suggesting relationships. Small-mesh reticulation is visible in species of *Caryocaris*, *Dictyocaris* and *Concavicaris* (as well as in the olenellid trilobites: Raw, 1936; Moore, 1958, fig. 5.22), and in *Ceratiocaris* and *Montecaris* such reticulation can be shown to arise from differential corrosion of the cuticular prisms (Rolfe, 1962a, pp. 45-47). The cuticle of the Burgess Shale specimens is too poorly preserved to ascertain whether this reticulation is sculptural or structural.

Holotype. USNM 139871. Plate 1, figure 2 and Text-figure 1.

Other material. The twelve specimens shown on Text-figure 1: USNM 139866a/b, 139867a/b, 139868-139870, 139872-139875, MCZ 5979/1, 5979/2a/b, 5979/3a b. Another specimen, USNM 139876, is a fragment of the anterior end only.

Dimensions of holotype. Maximum length parallel to hinge line: 98 mm. Maximum depth perpendicular to hinge line: 52 mm.

PROBOSCICARIS INGENS sp. nov.

Plate 1, figure 3; Text-figure 2

Diagnosis. Carapace valves only known; anterior beak relatively small; length of posterior margin *ca.* 0.28 of greatest depth of carapace; posterior margin sigmoidal.

Description. The ventral margin is more of a simple skewed curve than the convex and concave outline of *P. agnosta*. The posterior margin is shorter and hence is situated more dorsally than in *P. agnosta* and in addition this margin is sigmoidal rather than indented. The carapace margin is curled under, except along the dorsal border, suggesting the marginal rim common in the later phyllocarids.

The surface of the carapace is smooth but little is preserved of the original test save blotches of filmy black material. Occasional circular areas of silver sheen on the holotype may represent *Morania parasitica*.

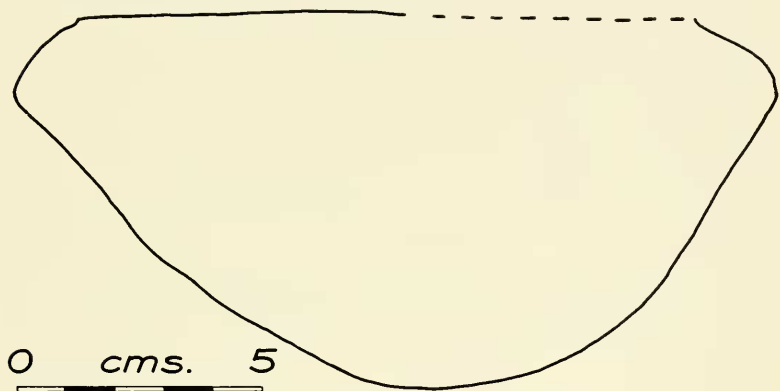


FIG. 2. Outline drawing of the holotype of *Proboscicaris ingens* sp. nov. — USNM 139865b. Postulated anterior to left.

Remarks. Again the carapace shape is distinctive, though the asymmetrical outline recalls that of *Isoxys*, which, however, is smaller and has the anterior and posterior dorsal extremities acuminate rather than truncate.

This species is the largest of the known Burgess Shale arthropods in terms of surface area of the carapace and was doubtless the one which Walcott had in mind when he wrote, "there are also fragments of the carapace of a very large form that possibly may be related to *Hurdia victoria*" (1912, p. 183). Individuals of *H. victoria* may be longer but they are also slenderer. Such large carapaces are of particular interest in this fauna since it is among them that a suitable adult for the hypothetically larval *Waptia fieldensis* might be sought (Fedotov, 1925, pp. 386, 389; Heldt, 1954, p. 180; Tiegs and Manton, 1958, pp. 292, 314; cf. Henriksen, 1928, p. 14; Størmer, 1944, p. 100). In this connection it seems worth recalling the striking resemblance of *Marria*, from this same deposit, to a crustacean nauplius (Ruedemann, 1931, p. 8) or metanauplius. A comparable Upper Ordovician form, *Paramarria*, occurs in association with an archaostrocan carapace, *Galenocaris* (Wells, 1944). If *Paramarria* is a naupliar stage, and the larval stage of *Galenocaris*, and its

aspect is not merely due to convergence for a planktonic existence (as that of *Mimetaster* and *Bostrichopus* seems to be), it would contrast with Recent Leptostraca. In the latter group, development is direct, the young hatching at a late stage. Similarly, *Naraoia* might be regarded as a larval merostomoid.

It is possible that *P. ingens* is simply an older instar of *P. agnosta*. However, such radical changes in shape are not common except in early ontogeny, and it seems better to distinguish this form as a separate species.

Holotype. USNM 139865a/b — part and counterpart.

Dimensions of holotype. Maximum length parallel to hinge line: 156 mm. Maximum depth perpendicular to hinge line: 75 mm.

Other material: USNM 139890 — a fragment of the posterior of a carapace valve, which must have exceeded 150 mm. long by 95 mm. deep when complete.

DISCUSSION

The lack of limbs or body segments precludes any discussion of the affinities of this new genus and the problem of classification of these early crustacean-trilobitoid forms has been summarized elsewhere (Rofe, 1962b).

It seems worthless to classify such isolated carapaces above the generic level in view of the limited number of characters available. Many of the genera attributed to phyllocarid families, or made the types of new families such as the Isoxyidae (junior synonym of Tuzoiiidae Raymond, 1935) and Pseudoaretolepididae of Brooks and Caster (1956, p. 13), will need to be brought together under the *incertae sedis* category shown above.

Some idea of the relative abundance of *Proboseicaris agnosta* in the Burgess Shale fauna may be gained from the following list of numbers of individuals of non-trilobite arthropods collected by the 1930 MCZ expedition, and recently curated by the writer:

TRILOBITOIDEA

<i>Burgessia bella</i> Walcott	54
<i>Emeraldella</i> or ? <i>Molaria</i> spp. indet.	3
<i>Leanehoilia superlata</i> Wale.	12
<i>Marrella splendens</i> Wale.	202
<i>Naraoia compacta</i> Wale.	3

<i>Opabinia regalis</i> Wale.	1
<i>Sidneyia inexpectans</i> Wale.	9
? <i>Yohoia plena</i> Wale.	1

TRILOBITOIDEA or CRUSTACEA *incertae sedis*

<i>Anomalocaris canadensis</i> Whiteaves	ca. 22
<i>Canadaspis obliqua</i> (Wale.)	7
<i>C. ovalis</i> (Wale.)	1
<i>C. perfecta</i> (Wale.)	76
<i>C. sp. indet.</i>	12
<i>Fieldia lanceolata</i> Wale.	1
<i>Hurdia triangulata</i> Wale.	1
<i>H. victoria</i> Wale.	16
<i>Isorxys acutangulus</i> Wale.	10
<i>Proboscicaris agnosta</i> sp. nov.	3
<i>Protocaris</i> cf. <i>pretiosa</i> Resser	1
<i>Tuzoia rectifera</i> Wale.	1
<i>T. sp. indet.</i>	2

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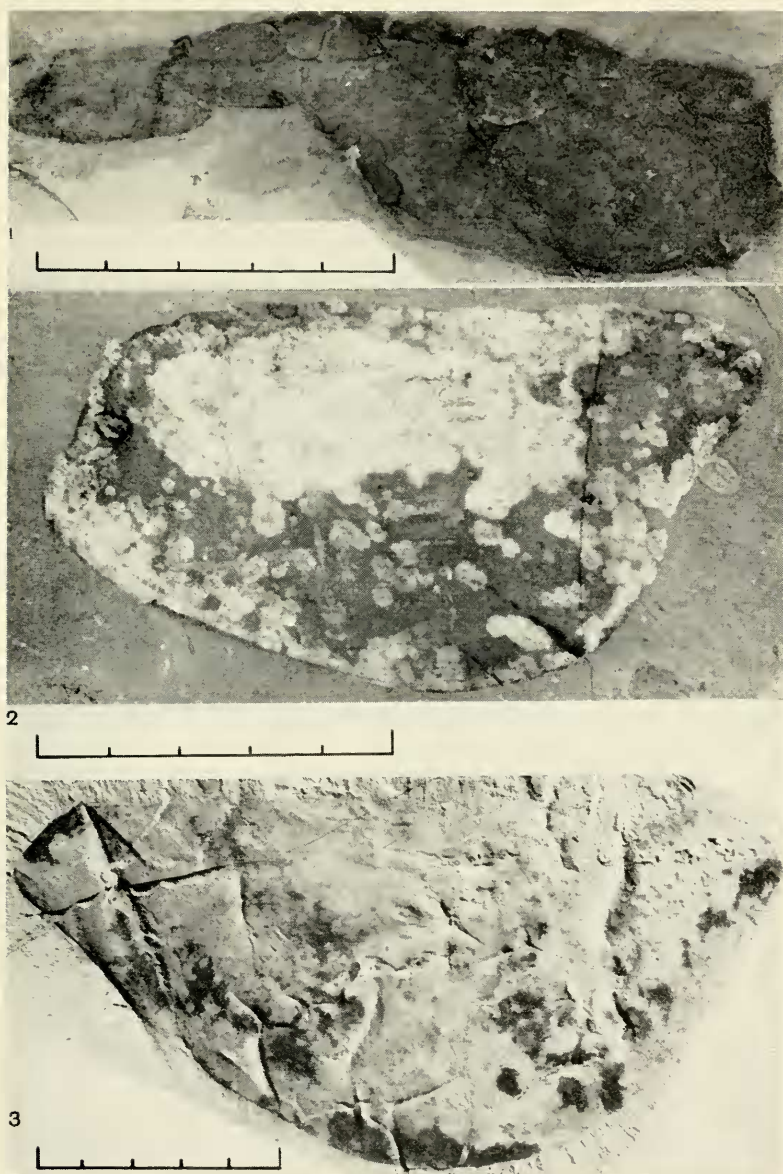


Plate 1

The scale beneath the Figures represents five centimeters.

Figs. 1-2. *Proboscicaris agnosta* gen. et sp. nov. 1. Left valve and displaced anterior beak of right valve of carapace. USNM 139872. 2. Holotype — USNM 139871 with anterior of valve at right. The silver blotches are the encrusting alga *Morania parasitica* Walcott. 3. *Proboscicaris ingens* sp. nov., holotype — USNM 139865b. Postulated anterior to left. From an